In the matter of

State of Oklaholma, ex rel., A. Drew Edmondson in his capacity as Attorney General of the State of Oklahoma, and Oklahoma Secretary of the Environment, C. MILES TOLBERT, in his capacity as the Trustee for Natural Resources for the State of Oklahoma, Plaintiffs

v.

Tyson Foods, Tyson Poultry, Tyson Chicken, Inc., Cobb-Vantress, Inc., Aviagen, Inc., Cal-Maine Farms, Inc., Cargill, Inc., Cargill Turkey Products, LLC, Georges, Inc., George's Farms, Inc., Peterson Farms, Inc., Simmons Foods, Inc., and Willowbrook Foods, Inc.
Defendants.

CASE NO. 05-CV-329-GFK-SAJ

in the United Station District Court
for the Northern District of Oklahoma

Expert Report

of

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EXHIBIT

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The field results obtained from the DR-2800 was reported as phosphate. To compare these results with the split sample results, the field results were converted to total P by multiplying the result by 0.3262.

Table 3.11.4-1 presents the results of an RPD comparison between the field measured P and the laboratory measured P. The average RPD was 42% out of 187 sample comparisons. **Figure 3.11.4-1** shows a scatter plot of the field P vs. laboratory P results. The correlation coefficient for these sets of data is 0.9736. Based on this evaluation, these data are considered comparable and acceptable for the intended data uses.

3.12 Cross Contamination Evaluation

As discussed in Section 3.1, evaluation of the collection and analytical procedure can only be performed in conjunction with stated objectives and the intended data use. For soils, the full suite or extended list of parameters was routinely analyzed on only the 0 to 2 inch samples. The purpose of this 0-2 inch sample was to document the types and relative concentrations of the contaminants that may run off the field or infiltrate the soil during rainfall events.

The soil samples from 2-4 inches and 4-6 inches were analyzed for only a small subset of the large list of parameters, including copper, arsenic, zinc, total phosphorus, soil test phosphorus (Mehlich P), organic matter, total nitrogen, aluminum, soluble salts and pH. The only quantitative use of the data in the deeper intervals to date has been to calculate a soil test phosphorus value for a 0-6 inch sample. A 0-6 inch sample is the standard depth on which agronomic fertility values are based. To determine the 0-6 inch value, the average of all three samples (0-2, 2-4 and 4-6 inches) was calculated. For this data use, any cross contamination between the intervals would not matter because an average value of all three intervals is the result being used. For other contaminants, the data were used to make general (non quantitative) observations such that concentrations were typically higher in the 0-2 inch sample, but that some downward movement of contaminants did occur when compared to control samples. Any potential cross contamination (see calculations below) would not affect these intended evaluations and data uses.

Any cross contamination in the 0-2 inch sample from deeper intervals left on the knife or in the core barrel would typically result in lower concentrations in the 0-2 inch sample because the concentrations in the deeper intervals are less. Therefore, any evaluations concerning the presence of poultry contamination in the shallow soils would be conservative. However, the maximum amount of cross contamination would only result in very small changes in the concentrations in the 0-2 inch sample and would not affect the reliability and intended data use. The relative percent change due to the maximum cross contamination is much less than the inherent natural relative percent difference between duplicate soil samples that have been ground, mixed completely and split using an unbiased riffle splitter. An example calculation is shown in the next paragraphs.

For soils, each LAL sampling areas had 20 sample locations with 1 to 3 core samples collected for each interval at each of the 20 locations. This would result in between 20 and 60 samples collected for each interval from each area. All the samples are then sent to the CDM laboratory for processing (including grinding, mixing, homogenizing and splitting) and then sent to the laboratory for analyses. A minimum total of 2,471 core samples were collected in the 73 sampling areas. If three core samples were collected per location, the number of samples would be greater than 4,000. If there were 83 instances of core samples that had soil on the probe and 40 instances of soil on the knife ("dirty knife"), this is an extremely small percentage of the total number of core samples. The maximum amount of soil left on the probe would be approximately 2 grams and the maximum amount of soil on a dirty knife would be 0.5 gram. Using these quantities and the assumed instances of soil on the probe and knife given above (83), the total mass of soil collected for the interval and the analytical results for actual samples, the maximum effect or change in the concentrations of the 0-2 inch sample was determined for parameters that were analyzed in the three intervals. As an example of the calculations, samples collected from area LAL-09A and analyzed for total phosphorus by method 6020 are discussed in the next few sentences. The P in the 0-2 inch sample was 1100 mg/kg and the P in the 2-4 inch sample was 745 mg/kg. The total amount of soil collected (20-60 probes samples) as measured in the CDM laboratory after mixing and processing was 2272.4 grams for the 0-2 inch interval. Assuming the total number of observations of soil on the core probe was two times for LAL-09A gives a total possible cross contamination amount of 4 grams. If these 4 grams were from the 2-4 inch interval and they were all incorporated into the 0-2 interval, the resulting change in P in the 0-2 inch would be 1.3 mg/kg or a concentration of 1098.7 versus the reported value of 1100 mg/kg. The relative percent difference between the two P results is 0.12 %. This is an extremely small change and will be compared to natural sample and analytical variability in the next paragraph.

As previously discussed in this section, quality control samples were collected to help evaluate data quality. This is required as one of the elements of systematic planning discussed in Section 3.1. One of these samples is called a duplicate. A duplicate sample may be collected in the field or in the laboratory. Note: the laboratory performing the analyses also does many quality control samples to assess data quality, including duplicates; in this paragraph, one type of CDM's independent quality control samples (submitted blind to the laboratory) is discussed. After the individual samples are received at the CDM laboratory, extensive mixing and homogenizing occurs, including air drying; removal of grass, twigs, etc.; sieving; multiple splitting; grinding to 0.074-0.250 mm; more mixing and splitting. This procedure is used to make sure that all subsamples (or splits) are similar. CDM actually takes one of these samples (called a duplicate) and sends it to the analytical laboratory blind (unique identification number) along with its matching subsample (with original ID number). That is, two subsamples will be analyzed identically; however, the laboratory does not know they are splits of the same sample. This process is performed on a routine basis and is used to evaluate the precision of the soil processing and laboratory analyses. The results for each of these samples are reported and the relative percent difference between the results for each parameter is calculated. The RPD difference is a measure of the inherent or natural variability in the soil sample after processing and the variability of a repeat analysis for the parameter at the analytical laboratory. The RPDs for each parameter are different. The average RPD in total P for duplicate samples that had been created from one soil sample was 5% (see **Table 3.11.2-1** and discussion in Section 3.11.2). The 5% RPD in the two concentrations is due to the inherent natural variability in soil and repeated laboratory analyses. This value is very low for soils and demonstrates that the CDM laboratory mixing was excellent and the laboratory analyses were very precise. For comparison, typical RPD values for metals in soils can range from 20 to 40%. However, the bottom line is that the differences potentially caused by the maximum amount of possible cross contamination assumed above (calculated in the example to be an RPD of 0.12% for total P) are always much less than the natural differences due to inherent variability in soil and laboratory analyses. See the next paragraph for overall RPD values. The assumed maximum possible cross contamination makes no significant difference in the results, reliability of the data or the data's intended use.

The maximum amounts of cross contamination in all soil intervals (expressed as RPD) from soil on the core probe is summarized for all major parameters in the following table (not all parameters were measured in the 2-4 and 4-6 sample intervals, so all parameters could not be analyzed). The first column shows the parameter; the second column shows the average RPD measured on duplicate samples (documented inherent and laboratory variability); the third column shows the lowest calculated change due to maximum cross contamination; the fourth column shows the highest calculated change due to maximum cross contamination; and the last column shows the average calculated change for all samples assuming contamination due to soil on the core probe. The values shown are calculated for all intervals and are for only those samples with assumed contamination.

Parameter	Documented RPD (%)	Calculated Low RPD (%)	Calculated High RPD (%)	Calculated Average RPD (%)
Phosphorus (Mehlich 3) (mg/Kg)	42	0.002	0.778	0.107
Total P (6020) (mg/Kg)	5	0.010	0.223	0.083
Total Arsenic (mg/Kg)	13	0.010	0.270	0.081
Total Copper (mg/Kg)	4	0.007	0.356	0.096
Total Zinc (mg/Kg)	9	0.011	0.345	0.093
Nitrogen Total (Inorganic + Organic) (mg/Kg)	11	0.010	1.008	0.112
Organic Matter (mg/Kg)	60	0.011	0.378	0.093
Fecal Coliform	113	-	-	-

Values for bacteria (fecal coliform shown as an example) could not be calculated because only the 0-2 inch sample is analyzed for bacteria. However, if analyzed in the deeper samples, the results for bacteria would be similar to the values for other contaminates. As shown, the potential changes in concentrations caused by the maximum amount of possible cross contamination on the core probe do not result in any substantial concentration changes and the relative percent changes are always much less than that observed due to documented variability in soil and laboratory analyses discussed above. The assumed potential maximum cross contamination does not affect the reliability of the data or its intended use.

Similar calculations to those shown in the above table were performed on samples assumed to have potential cross contamination due to a dirty knife. The calculations show that the RPDs are even lower than the values calculated for potential contamination on the core probe. The potential changes in concentrations caused by the maximum amount of possible cross contamination on the knife do not result in any substantial concentration changes and the relative percent changes are always much less than that allegedly observed due to documented variability in soil and laboratory analyses discussed above. The assumed potential maximum cross contamination does not affect the reliability of the data or its intended use.

As previously stated, a minimum of 2,471 (to over 4,000) core samples were collected. This paragraph assumes that the probe was driven through cow manure on 21 specific core samples. Using a similar approach as discussed above and assuming a carry over of 2 grams of cow manure into the 0-2 inch sample (and ignoring the fact that material such as grass, roots, and other loose organic matter was removed at the CDM laboratory prior to submittal for laboratory analyses), the resultant maximum potential change in concentrations was calculated. A very high value of fecal coliform for fresh cow manure of 2.6 x 106 MPN or cfu/g was used (based on ASAE D384.1 FEB03). In the few samples potentially affected by cow manure, the resultant RPD was below the RPD due to natural inherent variability and laboratory analyses by greater than a factor of two except for one sample. However, this one sample (LAL-15B) had an actual fecal coliform of 2000 MPN/g. This actual value is much lower than the calculated value using the above assumptions of maximum cross contamination. This shows that the maximum amounts of cross contamination did not occur and/or the value of fecal coliform assumed in the cow manure was too high. Because the concentration of fecal coliform in this one sample is relatively low, it does not affect any conclusions or data use. Assuming the 21 core samples affected eight specific composite samples, the concentrations of bacteria could have been affected by cow manure in these eight samples. The actual analytical results for these eight specific samples are shown in the following table:

Sample ID	Depth (inches)	Fecal Coliform (MPN/gram)	E Coli (MPN/gram)	Enterococcus (MPN/gram)
LAL-05B	0-2	2.4	2.4	1.4
LAL-11C	0-2	180	14	54000
LAL-12D	0-2	40	40	12000
LAL-15B	0-2	2000	2000	1800
LAL-16C	0-2	27000	240	9400
LAL-17A	0-2	27000	<0.18	240
LAL-20C	0-2	2	2	20
LAL-21B	0-2	24	24	33

As shown, the actual concentrations in many of these samples are very low and could not have been affected by cross contamination by cow manure. Similar to the previous examples, the potential changes in all other parameters for which the calculation could be made (e.g., copper, zinc) were very small (actual potential decreases in concentrations due to cross contamination). Overall, the potential changes in concentrations caused by the assumed maximum amount of possible cross contamination due to addition of cow manure do not result in any substantial concentration changes and the relative percent changes are much less than that allegedly observed due to documented variability in soil and laboratory analyses discussed above. The assumed potential maximum cross contamination does not affect the reliability of the data or its intended use.

As previously described, all soil samples were sent to the CDM laboratory for processing, sieving, complete mixing and homogenizing, grinding and splitting. During this processing, any cow manure or vegetation was removed. No cow manure was observed by the CDM laboratory. Any vegetation retained in the samples shipped from the fields would not be a concern because it was removed.

For waste poultry samples collected from the poultry houses, a collection scheme consisting of many samples (typically 18) at predetermined locations and compositing (mixing) was used to maximize the probability that representative samples were collected. A total of approximately 4 gallons of waste (average of 39,800 grams) was collected and then well mixed in the field. Removal of a subsample of approximately 500 mL (approximately 500 g) for bacteria (CDM) and another 32 oz (approximately 900 g) by CRA would not substantially change the analytical results. The average relative percent difference between duplicate samples collected in the field for fecal coliform was 94 percent. This difference is similar to duplicate soil samples that were completely mixed in the CDM laboratory. This indicates that field mixing was adequate. As previously discussed, after receiving the sample at the CDM laboratory, additional mixing, homogenizing and splitting were performed. Samples were shipped to laboratories for analysis. After removing the data associated with a sample that contained soil, the average contaminant concentrations in the defendants' waste matched literature values very closely. As shown in **Table 6.4-1**, average copper concentration was 420 mg/kg in defendants' waste and 479 mg/kg in literature (values from Jackson, et al, J. Environ. Qual., 32:535-540, 2003); average arsenic concentration was 18.6 mg/kg compared to the literature value of 16 mg/kg; potassium was 30,700 mg/kg compared to literature values of 33,000 mg/kg. Some values were not as close (e.g., barium). These comparisons indicate that the concentrations measured in the defendants' waste are representative of the typical poultry waste and can be used for the intended purpose of documenting the chemical and bacterial nature of the defendants' waste.

3.13 Summary and Conclusions

Quality assurance (QA) requirements were implemented to maximize delivery of high quality data. Strict data validation was not performed, instead laboratory data review consisted of an evaluation of holding times; matrix spikes; duplicate analyses, surrogate spikes and method blanks. Field QA/QC samples consisted of decontamination rinsate blanks, field duplicates and performance evaluation samples (blind standards).

As a result of the data evaluation performed by CDM, data qualifiers have been added to some of the sample results. The non-rejected data reported are suitable for their intended use. The achievement of the completeness goal for usable data provides sufficient data for project decisions. The detection limits reported were adequate for the intended use of the data. Over 98% of the aqueous and solid data produced during the investigation are considered complete.